

Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) EP 0 810 325 A2

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:  
03.12.1997 Bulletin 1997/49

(51) Int. Cl.<sup>6</sup>: E01F 15/04

(21) Application number: 97108114.6

(22) Date of filing: 20.05.1997

(84) Designated Contracting States:  
AT BE CH DE DK ES FI FR GB LI NL PT SE

(72) Inventor: Giavotto, Vittorio  
20 133 Milano (IT)

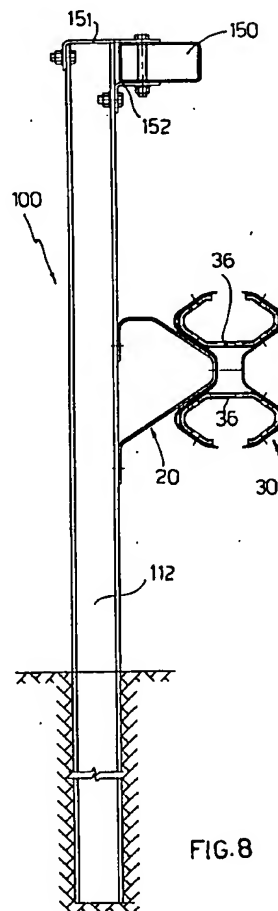
(30) Priority: 30.05.1996 IT MI961104

(74) Representative:  
Zavattoni Gusmeroli, Maria Chiara et al  
Racheli & C. s.r.l.,  
Viale San Michele del Carso, 4  
20144 Milano (IT)

(71) Applicant:  
Autostrada del Brennero S.p.A.  
38100 Trento (IT)

### (54) High-performance deformable steel guardrail

(57) A new guardrail comprises spaced out uprights or posts (12; 112 ...), on which is carried, by means of deformable spacer elements (20; 120 ...), a horizontal rail (30; 130 ...) comprising two strips (32, 34; 132; 134 ...) with a double wave, situated opposite each other, connected to each other at intervals by means of ribs or cross stiffening brackets (36; 136 ...) bolted to the strips. The strip and the ribs are made of steel. The spacer has a straight lower inclined side and a curved or bent upper side. In some variants the barrier has one or two continuous upper elements (150) at the top having considerable bending stiffness.



EP 0 810 325 A2

## Description

The invention refers to a guardrail for roads.

Various types of guardrails are known, both of metal and of concrete. In particular, a widely used guardrail has a longitudinal rail made of sheet metal with a curved profile, fixed at intervals to posts set in the ground, and placed at a height of about 50 cm, substantially corresponding to the height of the center of gravity of the passenger vehicles generally in use. The functions of guardrails are to keep a vehicle that hits them inside the carriageway, to prevent it as far as possible from assuming attitudes that would be dangerous for the passengers or for other vehicles and to absorb as much of the force of the impact of the vehicle as possible. Although guardrails of the most recent known types represent a considerable improvement with respect to the earlier ones, there is nevertheless always a tendency in the field to improve this product for safety purposes.

An aim of the present application is to obtain an improved performance from guardrails as far as safety is concerned, for both heavy and light vehicles.

More precisely the aim is to create a guardrail that is able to absorb high impact forces, for example when struck by a heavy vehicle such as a truck or the like, and that is able to keep the vehicle on the carriageway in such an attitude as to minimize any injury to the occupants.

A further aim is to create such a guardrail that can be produced at an economically acceptable cost.

A further aim is to create such a barrier that is highly durable.

These aims have been achieved with the guardrail as defined in claim 1; further new and interesting characteristics are stated in the subsequent claims.

More particularly, the guardrail of the invention comprises, on vertical uprights or posts, fixed in the ground and spaced apart, a longitudinal rail formed by a pair of sheet metal strips with a double-wave profile arranged specularly to each other and connected at intervals by steel ribs or brackets, the longitudinal rail being supported on the uprights by means of deformable spacers. In some variants the guardrail can be made with further continuous horizontal elements fixed to uprights over the longitudinal rail and set at a distance therefrom. The spacer can possibly be made with side flanges, so that as it is deformed against the upright, it can enfold it and prevent undesirable crosswise shifting between the upright and the longitudinal rail.

The strips and the ribs are preferably made of COR-TEN steel. The new barrier is able to absorb high impact forces. It is also able to keep vehicles on the road, even high, heavy vehicles, allowing a certain amount of rolling but preventing overturning. It is durable. Lastly, it allows drivers a good view because any longitudinal elements have a reduced height.

The invention will be described in greater detail below, purely by way of non-limiting example with refer-

ence to the appended figures in which:

Figure 1 is a sectional view of a first embodiment of a guardrail according to the invention, on a reduced scale; the section is taken along the vertical plane 1-1 in Figure 2;

Figure 2 is a broken-away front view of a portion of the guardrail in Figure 1, reduced in scale with respect to said figure,

Figure 3 is an end view of the longitudinal rail of the barrier, in a part where it is provided with ribs;

Figure 4 is an end view of a rib element;

Figure 5 is bottom view of a rib element;

Figure 6 is an end view of a spacer;

Figure 7 is a view from the left with respect to Figure 6, that is a rear view of a spacer element;

Figure 8 is a vertical section of a variant of the guardrail;

Figure 9 is a vertical section of a further variant of the guardrail;

Figure 10 is an interrupted front view of the guardrail in Figure 9;

Figure 11 is a view of a variant of the spacer element used in the barrier in Figure 9;

Figure 12 is a rear view of the spacer element in Figure 10, that is to say a view from the left of said figure;

Figure 13 is a section along 13-13 in Figure 11;

Figure 14 is a vertical section of a guardrail according to the invention in a further embodiment;

Figure 15 is a vertical section of a further variant of the guardrail.

The invention will now be described in its simplest embodiment with reference to Figures 1 to 5.

A guardrail 10 in said figures comprises a plurality of spaced out uprights or vertical posts, 12, made of metal section bar, for example I-beam or channel-beam, a substantial portion of which, indicatively about 1200 mm, is fixed in the ground and another portion of which protrudes from the ground.

Spacers 20 which will be better described below are fixed to the posts 12 by nuts and bolts (the bolts are not shown but their axes are indicated by 14). A longitudinal rail 20 is applied to the spacers 20 and fixed by

means of nuts and bolts.

Each spacer 20 (Figures 6 and 7) is made of sheared and bent sheet steel and is substantially C-shaped, comprising end fixing tongues 21 and 22, an inclined lower portion (preferably inclined about 57° with respect to the vertical) indicated by 24, a substantially vertical middle portion 25, and an upper portion that is curved or comprises an inclined portion 26 (about 56° with respect to the vertical) and a horizontal portion 26' that ends with tongues 22.

The longitudinal rail 30 comprises two longitudinal strips 32, 34 with a double wave-shaped profile, arranged one specularly to the other, that is to say facing each other, joined together at intervals by arched ribs or cross stiffening brackets 36. The ribs 36 are preferably situated to coincide with each upright and each spacer. Each sheet metal rib (Figures 3, 4, 5) is substantially C-shaped with the arms of the C substantially corresponding to the shape of the facing waves of the strips, with the opening of the C disposed in the distal part of the strips. The connection between each rib and the pair of strips is made by means of bolts 38, whilst bolts 40 join together the rib, the strip and the spacer. Each rib has a longitudinal extension which is about three times its height and is interrupted by stiffening beads 42, made by deformation of the sheet.

The particular shape of the longitudinal rail and the spacers allows a high impact force to be absorbed, mainly through deformation of the spacers, which moreover, as they are deformed, cause lifting of the longitudinal rail which helps straighten the vehicle and prevent it from overturning.

A variant of the guardrail illustrated in Figure 8 is indicated by reference numeral 100 and is suitable for sustaining heavier loads than the guardrail in Figure 1. The elements of the guardrail 100 that correspond to the elements of the guardrail 10 have the same reference numerals and will not be described in detail. The uprights 112 of the guardrail 100 have a greater height than that of the uprights 12 of the previous guardrail, in particular they extend for a certain distance above the height of the longitudinal rail 30. The upper ends of the uprights 112 carry an upper longitudinal element 150, generally tubular, fixed to said uprights by means of connection plates 151 and 152. The connection plates 151, 152, the upright and the tubular element are fixed together by means of nuts and bolts. The tubular element 150 generally has a rectangular section with chamfered corners and, with respect to the carriageway, is set back with respect to the longitudinal rail 130.

Figure 9 shows a further variant of the guardrail able to withstand even heavier impacts than the guardrail in Figure 8. The guardrail 200 in Figure 9 comprises elements corresponding to those of the guardrail in Figure 1, which have the corresponding reference numerals and will not be described in detail here. In the case in Figure 9, a spacer 220 (Figures 11-13) has flanges indicated by 227 on the sides of the inclined portion 224. The spacer 220 has the property of being able,

when deformed, to absorb the force of impact, the flanges 227 thereof enfolding the upright 212 on one side and the other, helping to avoid longitudinal shifting between the elements of the guardrail. The spacer 220 can be used with any guardrail according to the invention.

The guardrail 200 further comprises two longitudinal vertically spaced tubular elements 250 and 250', applied to the upright 212 so that their ends towards the carriageway are set back towards the upright with respect to the longitudinal rail 30. A preferred height for the two longitudinal elements 250, 250' is about 1250 mm from the road surface for the bottom longitudinal element and 1550 mm from the road surface for the top longitudinal element. These dimensions are, however, subject to variation.

It will be noted that the guardrails 10, 100, 200 leave an ample free space between the longitudinal rail and longitudinal elements, so that the occupants of the vehicles travelling along the carriageway can see the view.

Figure 15 illustrates a variant 300 of the guardrail, suitable as a directional separator or traffic divider. The variant 300 comprises elements corresponding to those of the other guardrails which are indicated with the same reference numerals and will not be described in detail. The guardrail 300 in particular comprises spacers 20 and longitudinal rails 30 on both sides 312 of the uprights. The guardrail 300 can further comprise one or more upper longitudinal elements 350, on each side of the uprights.

The guardrails described are made of sheet metal, particularly sheet metal that withstands atmospheric agents, such as, indicatively, COR-TEN sheet steel.

## Claims

1. A guardrail of a type comprising uprights (12; 112; 212; 312) spaced out along a carriageway and longitudinal rails with a wave-shaped profile carried on the uprights characterized in that said longitudinal rails (30) comprise a pair of metal section irons (32, 34) with a double wave arranged facing each other; and connecting ribs (36) between said two longitudinal section irons with a double wave; said guardrail also comprising deformable spacers (20; 220) connecting said uprights and said longitudinal rails.
2. A guardrail according to claim 1, characterized in that said ribs (36) are made of sheet metal, have a C-shaped profile and are arranged in pairs between the cavities formed by two corresponding facing waves of said section irons and are joined to said section irons at least at the uprights.
3. A guardrail according to claim 1, characterized in that said spacers (20; 220) are made of sheet

metal, are C-shaped and comprise a first inclined lower portion (24; 224), an intermediate portion (25) and a curved or composite upper portion (26, 26').

4. A guardrail according to claim 3, characterized in that said inclined lower portion (24; 224) is inclined about 57° with respect to the vertical when the spacer is mounted on the upright.

5. A guardrail according to claim 3, characterized in that the lower inclined part (224) comprises at the ends upturned flanges (227) with a space between them not smaller than the width of the upright.

6. A guardrail according to claim 1, characterized in that it comprises, above said longitudinal rail (30) and at a distance from it, one or more longitudinal elements (150; 250; 250'; 350) set back with respect to said longitudinal rail.

7. A guardrail according to claim 6, characterized in that said longitudinal elements are tubular metal sections fixed to the uprights.

8. A guardrail according to claim 1 for a directional separator, characterized in that it comprises two said longitudinal rails (30) on one side and the other of the uprights, and/or upper longitudinal elements (350) spaced vertically from said longitudinal rails.

5

10

15

20

25

30

35

40

45

50

55

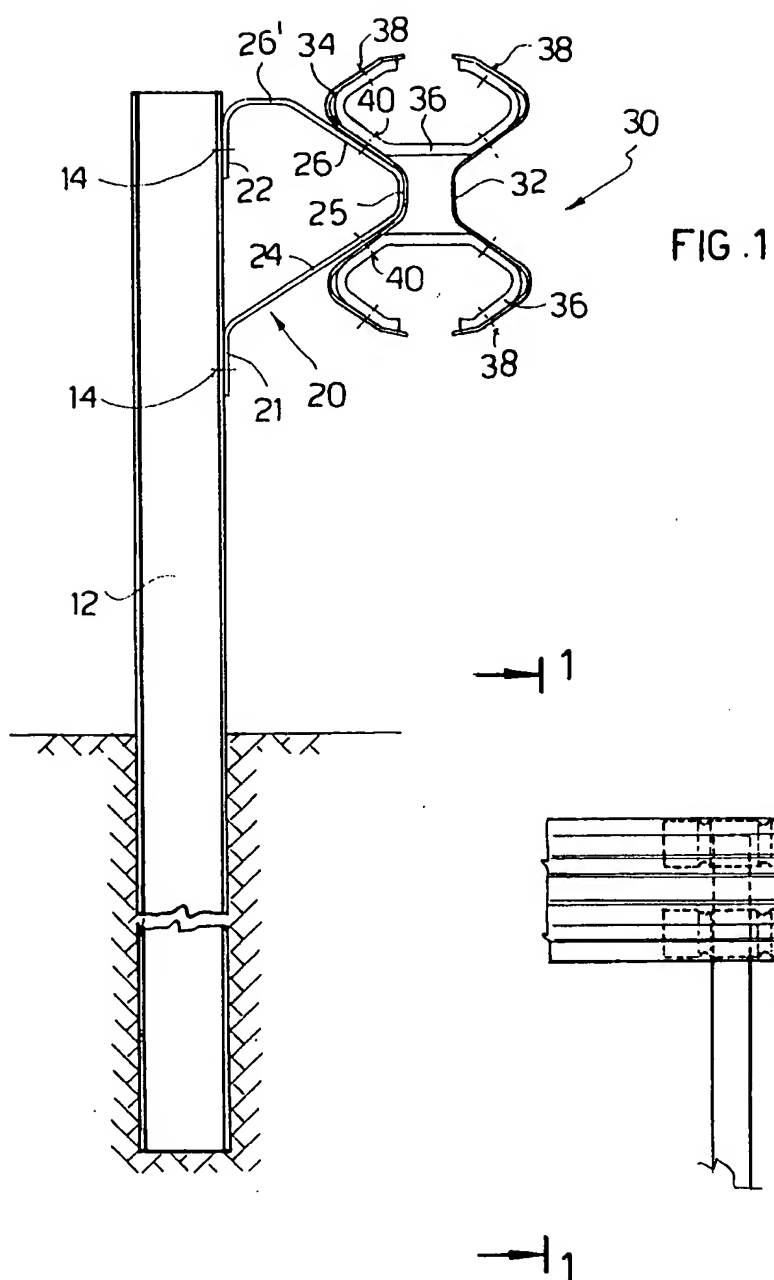
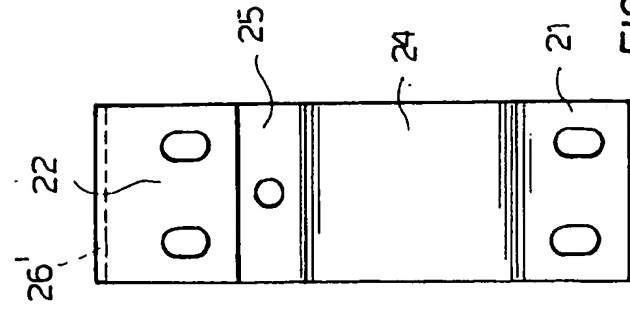
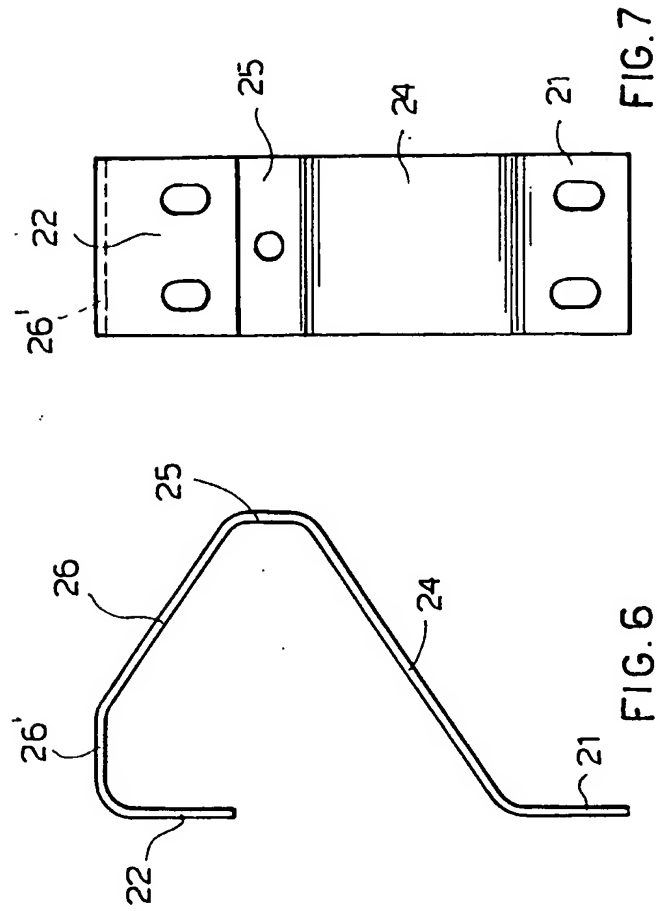
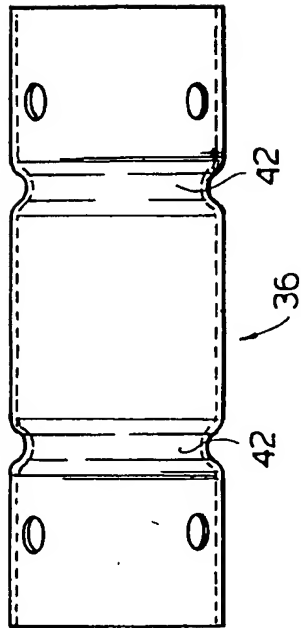
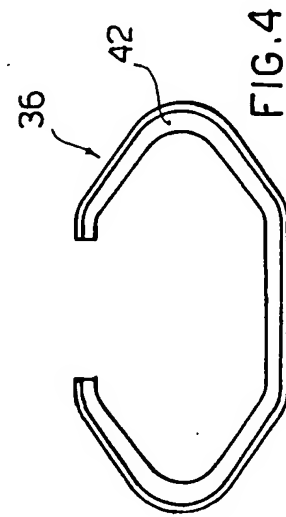
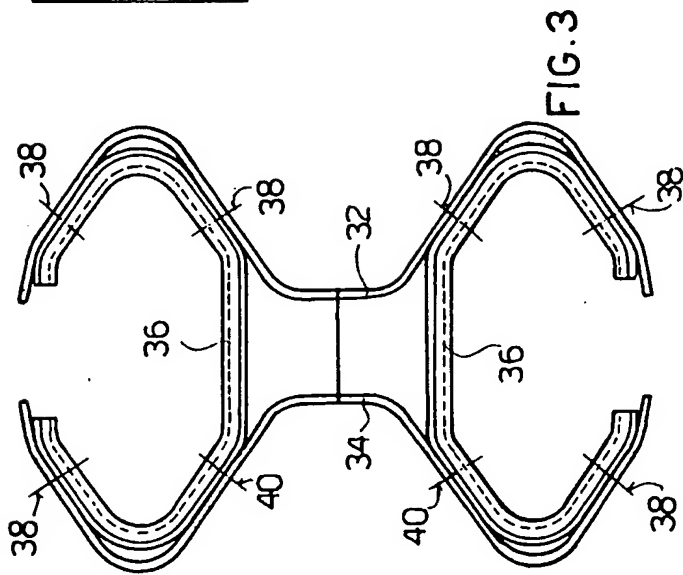
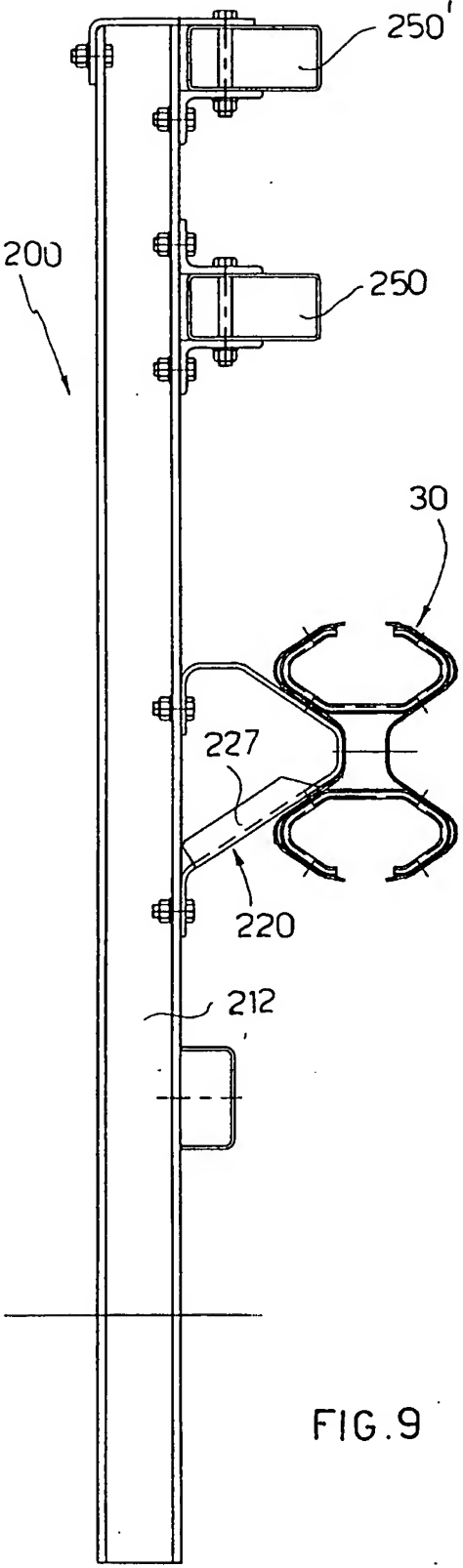
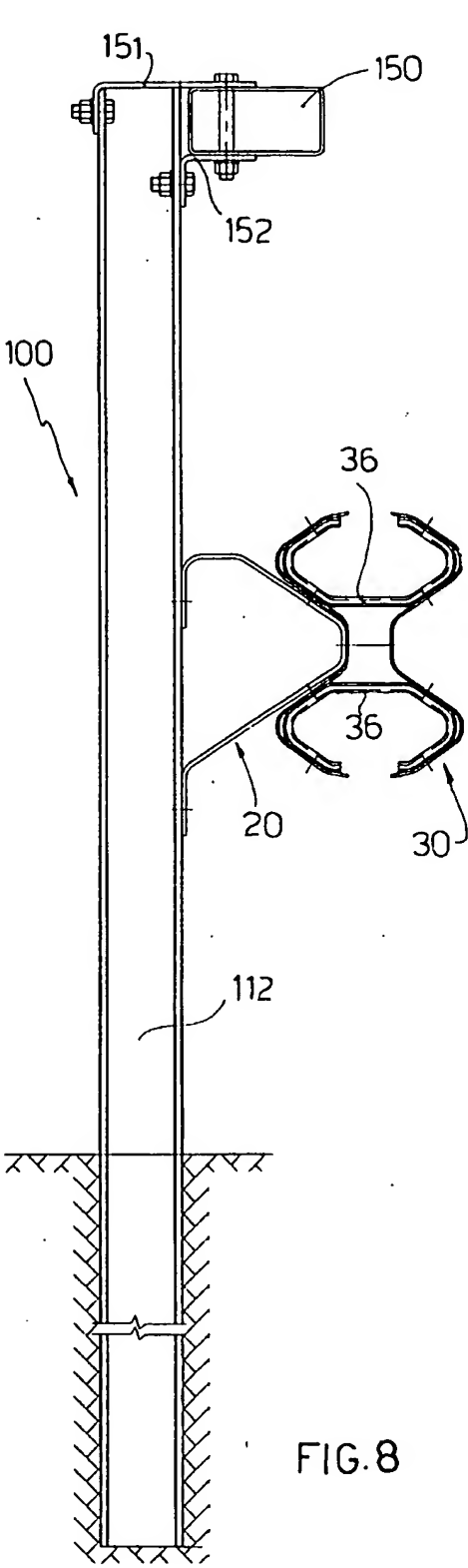


FIG. 2





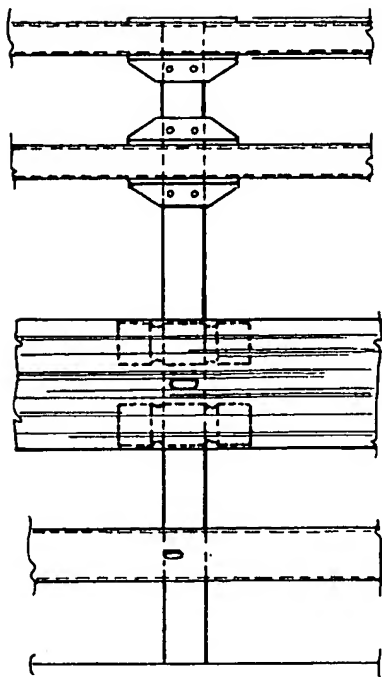


FIG. 10

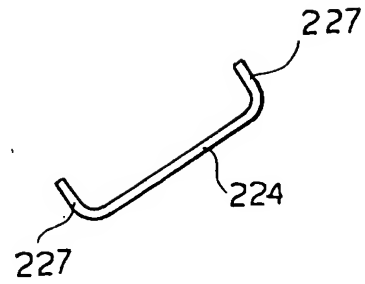


FIG. 13

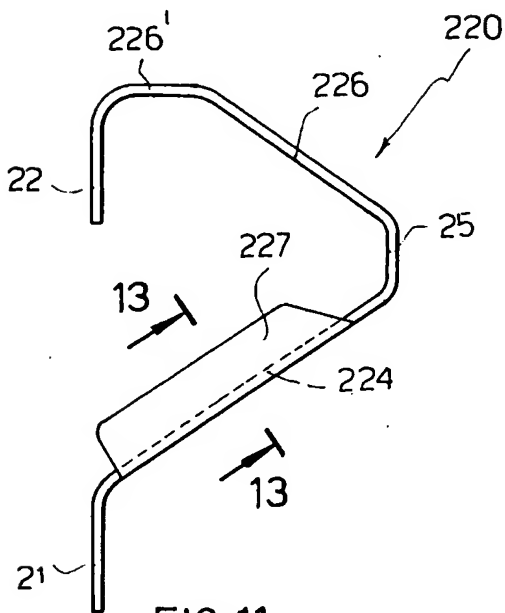


FIG. 11

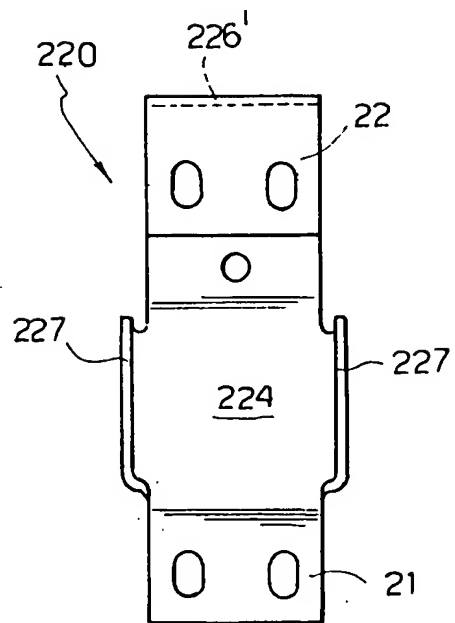
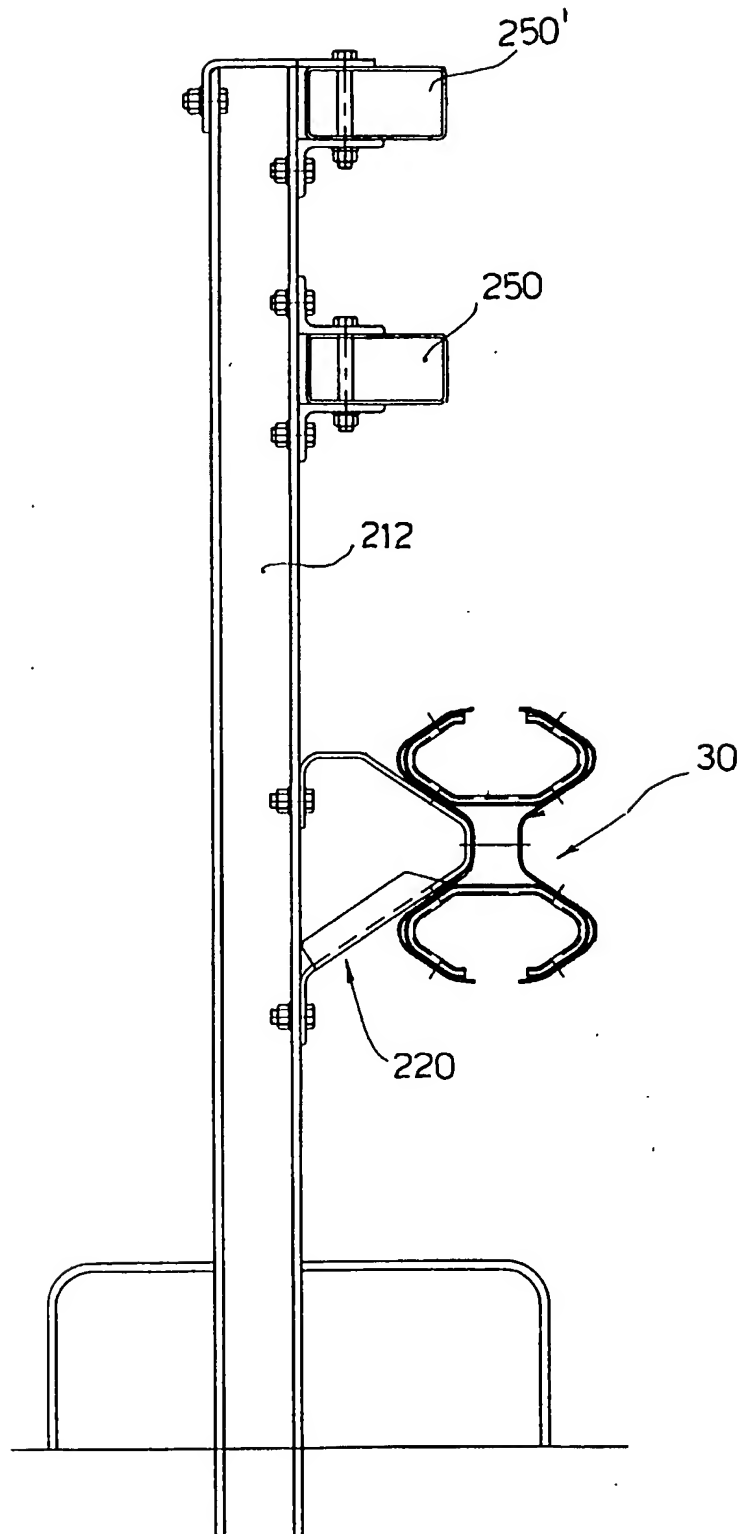


FIG. 12



FIG.14



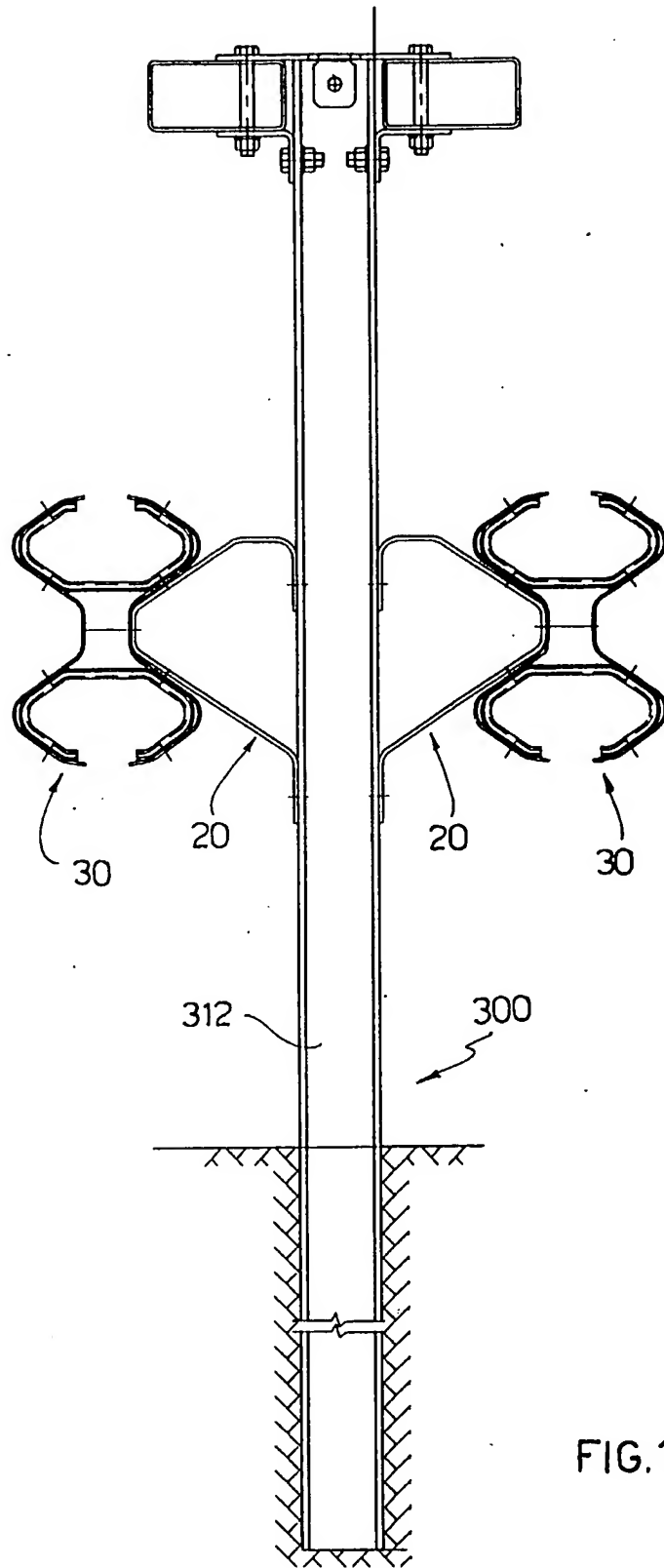


FIG.15



(11) **EP 0 810 325 A3**

(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:  
**14.07.1999 Bulletin 1999/28**

(51) Int. Cl.<sup>6</sup>: **E01F 15/04**

(43) Date of publication A2:  
**03.12.1997 Bulletin 1997/49**

**(21) Application number: 97108114.6**

(22) Date of filing: 20.05.1997

**(84) Designated Contracting States:**  
**AT BE CH DE DK ES FI FR GB LI NL PT SE**

**(72) Inventor: Giavotto, Vittorio**  
**20 133 Milano (IT)**

(30) Priority: 30.05.1996 IT MI961104

**(74) Representative:**  
**Zavattoni, Maria Chiara et al**  
**Rachell & C. s.r.l.,**  
**Viale San Michele del Corso, 4**  
**20144 Milano (IT)**

(71) Applicant:  
**Autostrada del Brennero S.p.A.**  
**38100 Trento (IT)**

**(54) High-performance deformable steel guardrail**

(57) A new guardrail comprises spaced out uprights or posts (12; 112 ...), on which is carried, by means of deformable spacer elements (20; 120 ...), a horizontal rail (30; 130 ...) comprising two strips (32, 34; 132; 134 ...) with a double wave, situated opposite each other, connected to each other at intervals by means of ribs or cross stiffening brackets (36; 136 ...) bolted to the strips. The strip and the ribs are made of steel. The spacer has a straight lower inclined side and a curved or bent upper side. In some variants the barrier has one or two continuous upper elements (150) at the top having considerable bending stiffness.

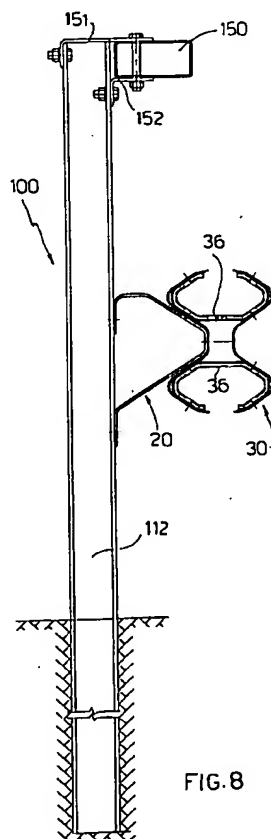


FIG. 8

**EP 0 810 325 A3**

EP 0 810 325 A3

European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 97 10 8114

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	FR 1 572 041 A (MORTEO SOPREFIN) 20 June 1969	1-4	E01F15/04
Y	* page 2, line 35 - page 4, line 8; figures 3,4 *	5-8	
X	FR 1 486 538 A (NAT. RES. DEV. CORP.) 16 October 1967	1	
A	* page 4, column 1, line 63 - page 5, column 1, line 56; figures 10,11 *	3,8	
Y	FR 2 660 677 A (POMERO CLAUDE) 11 October 1991	5	
A	* page 3, line 21 - page 6, line 20; figures 1,3 *	3	
Y	DE 42 24 998 C (SPIG) 26 August 1993	6-8	
A	* column 4, line 4 - column 5, line 19; figures 1,3,5 *	1-5	
P,A	DE 195 36 915 A (SPIG SCHUTZPLANKEN PROD GMBH) 27 February 1997	1-8	
A	DE 19 49 782 U (BERTRAMS) * page 4, line 5 - page 6, line 16; figure 1 *	1-8	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			E01F
Place of search THE HAGUE		Date of completion of the search 21 May 1999	Examiner Verveer, D
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04/C01)

EP 0 810 325 A3

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 97 10 8114

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-05-1999

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
FR 1572041	A	20-06-1969	CH	489669 A	30-04-1970
FR 1486538	A	16-10-1967	NONE		
FR 2660677	A	11-10-1991	NONE		
DE 4224998	C	26-08-1993	CH	687087 A	13-09-1996
			ES	2068761 A	16-04-1995
			FR	2694313 A	04-02-1994
DE 19536915	A	27-02-1997	AT	176694 T	15-02-1999
			DE	59601292 D	25-03-1999
			EP	0761889 A	12-03-1997
			ES	2127594 T	16-04-1999
DE 1949782	U		NONE		

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82